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AEC-NASA TECH BRIEF

Space Nuclear Systems Office

PUZZLE: A Program for Computer-Aided Design of Printed Circuit Artwork

A computer program, PUZZLE, aids in solving the spacing problems encountered in printed circuit (PC) design. The program minimizes the man-hours required to produce the layout solutions and drawings for the manufacture of etched PC boards. It is intended to have maximum use for two-sided PC boards carrying integrated circuits. The program can also be used to design discrete-component circuits.

PUZZLE allows the board dimensions to be coded, permitting variable spacing on the connector tabs. Hence, the program yields a complete representation of the finished board. Any or all edges may have connector tabs on them, and, within the physical limitations, any number of connectors may appear on the tab. It is also possible to produce a board with no connector tabs. To leave as much design control as possible in the hands of the designer, component placement is determined solely by the input data and may not be modified by the program.

PUZZLE can be applied to boards of up to 12.7 × 25.4 cm (5 × 10 in.) in size. The field is an array of points on the intersections of grid lines, with 0.127 cm (50 mil) centers horizontally and vertically. All components are placed on the grid, and all interconnections are rectilinearly routed along the intersections of the grid. The field is further subdivided into a grid of 2.54 cm (1 in.) squares to aid in component placement. A library of defined component codes greatly reduces the effort required for writing a wiring table.

After the data cards containing the wiring list have been read into the computer, the program begins to solve the topological problem of finding interconnection paths between the points specified. All paths must stay on the 2.54 cm grid lines. In general, vertical lines are on the component side of the board, and horizontal lines are on the wiring side.

The operational procedure of the computer program can be divided into three major sections: the initialization process, the actual routing of connections, and production of the graphic output. The initialization process—the acceptance of data—includes reading the input, testing it for compliance with input specifications, and storing the connections to be made as data points. Data can be input via a CRT screen and teletype, allowing considerable variation in component placement. Editing features allow modification of input when desirable. The input data are scanned to establish the horizontal and vertical limits in the connection mapping.

Then the graphic output is begun. The label is written, the broad outline or grid is established, and the necessary pads are drawn. The data are sequenced so that the shortest paths are drawn first, and the connections are then routed. A stepping procedure is used to do the mapping, and a "smoothing" process is applied. After several steps are completed, tests are made to see whether every direction change was essential. When the path is completed, a message is printed and the path recorded.

In the production of the graphic output, the composite picture is drawn first. If there are no rejected data and no mission connections, or if requested, two additional graphs are drawn, one for each side of the board. Immediate response on the CRT screen displays the layout for review before final drawing. After a successful plot of the interconnections has been obtained, the wiring-side and

(continued overleaf)

component-side plots are overlaid on a board outline produced by conventional drafting techniques. Any necessary retouching is done at this point.

References:
1. Zane, Ronald; and Harrell, Deanna A. Wilber: PUZZLE: A Program for Computer-Aided Design of Printed-Circuit Artwork. UCRL-17814, September 1967.
2. Zane, Ronald; and Harrell, Deanna A. Wilber: Computer-Aided Design of Printed-Circuit Artwork. UCRL-18172, April 1968.

Note:

Requests for further information may be directed to:

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Patent status:

No patent action is contemplated by AEC or NASA.

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